TITLE OF THE INVENTION

[0001] Surface Treated Particulated Polymeric Matrix for Forming an Exposed Surface of a Weatherseal.

CROSS-REFERENCE TO RELATED APPLICATIONS

[0002] Not Applicable.

STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH OR DEVELOPMENT

[0003] Not Applicable

REFERENCE TO A "SEQUENCE LISTING"

[0004] Not Applicable.

BACKGROUND OF THE INVENTION

FIELD OF THE INVENTION

[0005] The present invention relates to a vehicular weatherseal, and more particularly, to a vehicular weatherseal having an exposed surface defined by a multitude of surface roughness forming particles in a polymeric matrix, wherein one section of the exposed surface is defined by the particles having a first average position relative to the surface and a second section is defined by a different second average position relative to the surface. That is, at least a portion of the exposed surface is treated to locate a number of the particles in an alternative (or predetermined) location in the polymeric matrix.

BACKGROUND ART

[0006] Many vehicles employ windows formed of glass panels, wherein the window may be fixed or moveable relative to a portion of the vehicle. A common construction includes the use of a glass panel in a door, wherein the door and the glass panel move relative to the remainder of the vehicle, and the glass panel moves relative to the door. In this construction, the glass panel is frequently moved between an open position and closed position with respect to the door and/or a portion of the vehicle frame. Increased business transactions such as restaurant, banking and pharmacy services are now regularly offered in a drive-through format. These transactions require the repeated release and engagement of the glass panel and the vehicle. The repeated opening and closing of the glass panel places significant stress on the seal between the glass panel and the vehicle.

[0007] Alternative weatherseals are employed at the interface of a fixed panel, such as a front or rear window, and the adjacent portion of the vehicle body.

[0008] Traditionally, a weatherseal is employed at the interface between the glass panel and the vehicle door and/or the vehicle. The interface between the weatherseal and the glass panel must be sufficient to substantially preclude the penetration of water, air borne particles and air along the periphery of the glass panel, while still permitting ready engagement and disengagement of the glass panel without requiring excessive force.

[0009] Conventional sealing structures include a soft synthetic resin or synthetic rubber. However, such weatherseals do not provide for the ready opening and closing of the glass panel relative to the seal. Further, a large force is often loaded on the window glass thus resisting opening or closing of the window glass.

[0010] Prior weatherseals often employed a fiber flocking such as polyester on the area in which the weatherseal contacts the glass panel. However, the flocking process is relatively complicated. The complex manufacturing process adds to the cost of the weatherseal. Further, the flocking can be removed or worn away. As the flock is worn from the weatherseal, the loading force substantially increases.

[0011] As a solution to the complications associated with flocking, a contact surface of the weatherseal can be coated. However, these coatings are typically not as aesthetically pleasing as non coated areas. While the coating helps reduce friction, the coating complicates the manufacturing process, as the coating must be limited to specific areas of the weatherseal.

[0012] Therefore, a need also exists for a weatherseal that can be configured to provide distinct functions, without requiring incorporation of alternative materials. The need also exists for a weatherseal which provides enhanced appearance, while maintaining the necessary sealing functions. The need also exists for a weatherseal exhibiting reduced friction when engaging and disengaging a panel, while providing an aesthetically pleasing appearance in select locations. A need further exists for a method of forming such a weatherseal.

BRIEF SUMMARY OF THE INVENTION

[0013] The present invention provides a vehicular weatherseal having an exposed surface defined by a multitude of surface roughness forming particles in a polymeric matrix, wherein a first section of the matrix defines a first surface roughness (coefficient of friction) and a second section of the matrix defines a different second surface roughness (coefficient of friction). That is, in one section of the matrix the particles are located in a first substantially predetermined orientation relative to a surface of the matrix and in the second section of the matrix the particles are located in a different second substantially predetermined orientation relative to the surface of the matrix. Thus, the present invention allows for the processing of a single mixture of constituents in a single extrusion, which can form a sealing surface along one section of the particulated matrix and can exhibit a substantially different appearance along a second section of the matrix.

[0014] In a preferred configuration, the particulated polymeric matrix is formed by extruding a mixture of a polymeric material and surface roughness forming particles. The extrusion can be simultaneous, subsequent or a coextrusion with the body of the weatherseal, wherein the particulated matrix is located on predetermined portion(s) of the body. Subsequently, and preferably prior to the particles becoming set within the matrix, at least a section of the particulated polymeric matrix is subject to downstream processing, whereby at least one of a different coefficient of friction; visual appearance; texture, surface roughness, or particle distribution within the matrix is implemented.

[0015] Thus, an exposed surface of the weatherseal can be readily configured to provide either a friction reducing surface, or an aesthetically pleasing surface without requiring a change in materials or manufacturing steps for formation of the weatherseal. The present invention allows for selected sections of the exposed surface of the weatherseal to provide for sealingly engaging a panel, wherein the weatherseal reduces friction and noise generation upon relative motion between the weatherseal and the panel, the relative motion including intended engaging and disengaging motions as well as vehicle flexure induced motions. In addition, the same particulated polymeric matrix can be configured to provide a desired surface appearance such as smooth or textured non-particulated surface.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWING(S)

[0016] Figure 1 is a perspective view of a vehicle employing a number of seals.

[0017] Figure 2 is a perspective view of a further configuration of the weatherseal.

[0018] Figure 3 is a perspective view of an alternative configuration of the weatherseal.

[0019] Figure 4 is a perspective view of another configuration of the weatherseal.

[0020] Figure 5 is a cross sectional schematic view showing the particle location in a treated and untreated section of the weatherseal.

[0021] Figure 6 is a perspective view of alternative configurations of the particulated matrix and the treated and untreated sections of the weatherseal.

DETAILED DESCRIPTION OF THE INVENTION

[0022] Referring to Figure 1, the weatherseal 10 of the present invention may be employed at various locations on a motor vehicle 12. The weatherseal 10 may be located between a portion of the frame of the vehicle 12 and a moveable portion such as a door or window panel 14. Alternatively, the weatherseal 10 may be located between portions intended to be fixed such as a windshield or a rear window and the vehicle 12.

[0023] Although the term panel 14 is used to describe a window, it is understood that panel may be any of a variety of materials such as, but not limited to glass, plastics, composites, or metal, which may be coated, painted, surface treated or bare. Therefore, the panel 14 may include glass such as windows, and metal or composites such as vehicle body parts, which may be intended to be stationary or movable with respect to the panel.

[0024] The weatherseal 10 may have any of a variety of cross sectional profiles, such as, but not limited to "U", "J", "C" or "L" shaped. Typical profiles are shown in Figures 2-4 and 6.

[0025] The weatherseal 10 includes a weatherseal body 20 and a particulated matrix 46 forming an exposed surface 40, wherein the exposed surface can define portions of the weatherseal which contact the panel 14 or portions of the weatherseal that function as trim, or non sealing areas.

[0026] The weatherseal body 20 forms a base for the particulated matrix 46 and can be any of a variety of materials. The weatherseal body 20 may be a thermoplastic, thermoset or a combination of thermoplastic portions and thermoset portions. A preferred thermoplastic material includes thermoplastic elastomers or olefinic TPEs. A preferred thermoset material is EPDM. The combination of materials in the substrate may be selected to provide a desired rigidity and softness for various sections of the weatherseal 10. Additionally, the weatherseal body 20 may include a reinforcing structure 22 such as a metal carrier, wire or thermoplastic material. The weatherseal body 20 may have any of a wide variety of cross-sectional profiles. For example, the cross-section profile may be generally "U", "J", "C" or "L" shaped or planar.

[0027] As shown in Figures 2-4, the particulated matrix 46 can be located on any portion of the weatherseal body 20. The particulated matrix 46 includes an exposed surface which can define a contact surface 42 for contacting the panel 14. It is also understood the material of the particulated matrix 46 can be used to form the weatherseal body 20, wherein selected exposed sections of the matrix are surface treated. Referring to Figure 5, the particulated matrix 46 is defined by a multitude of surface roughness forming particles 50 in a polymeric material 48. In certain configurations, the particles 50 form at least a portion of the exposed surface and hence the contact surface 42. The particles 50 can be selected and sized to provide a sufficient roughness in the contact surface 42 to reduce noise generation upon relative movement of the weatherseal 10 and the panel 14. The particles 50 and surface treatment can be selected to reduce noise transmission across the vehicle-weatherseal interface, as well as reduced squeak and itch caused by movement of the weatherseal relative to the vehicle. The particles 50 and surface treatment can be further selected to reduce friction between the vehicle 12 and the weatherseal 10 without sacrificing the desired sealing function. That is, the weatherseal 10 can substantially preclude environmental migration across the panel-weatherseal interface under intended operating parameters.

[0028] The particles 50 can be uniformly distributed throughout the area of the matrix 46 and thus the exposed surface 40. That is, any given representative area of the

exposed surface has a generally equal number of particles 50. Further, the particles 50 can be uniformly distributed throughout a thickness of the particulated matrix 46.

[0029] In the present invention the surface of the particulated matrix 46 is treated to alter the particulated matrix from an "as formed" configuration. However, it is understood different sections of the particulated matrix 46 can be subject to different treatments, thereby resulting in both sections being different from the "as formed" configuration. The surface treatment can include any of a variety processes including embossing, electromagnetic stimulation, ultrasonic exposure, laser treating, grinding, brushing, burnishing, impacting with flowable media, rolling and/or calendaring. The surface treatments can be used to orient or position the particles 50 in a substantially uniform manner relative to the surface of the particulated matrix 46. For example, the surface treatment can be used to dispose the particles 50 coplanar with the adjacent polymeric matrix. Alternatively, the surface treatment can impart macro size textures to the particulated matrix 46, such as textured skin or patterns wherein the particles define a smaller scale surface texture.

[0030] The particulated matrix 46 can extend along a longitudinal dimension of the weatherseal 10 to be located along the entire length of the weatherseal or a portion of the length of the weatherseal. Further, the particulated matrix 46 can extend along intermittent lengths of the weatherseal 10. The particulated matrix 46 can have a continuous surface treatment, or intermittent surface treatment, wherein the matrix is either continuous or intermittently located along the weatherseal 10. Thus, in the intermittent surface treatment configurations there are boundaries or transitions between the sections that are surface treated and those that are not surface treated. It is also understood there may be a transition between sections having different surface treatments. The transition can be formed to be abrupt defining a clear line of demarcation or discontinuity between the sections. Alternatively, the transition can be gradual or stepped.

[0031] For certain areas of the particulated polymeric matrix 46, such as the contact surface 42, the particles 50 can be located proximal to the surface of the exposed surface 40. The exposed surface 40 and the contact surface 42 are thus defined by a plurality of projections 44 and the intermediate or interstitial sections of the matrix. The projections 44

generally define the contact area between the contact layer 40 and the panel 14. The projections 44 may have a density of approximately 1 to 5 projections per square millimeter. Typically, the projections 44 extend from an adjacent portion of the contact layer 40 by a distance of approximately 5 to 120 microns. It is understood that design considerations may require alternative sized projections, and hence particles.

[0032] The projections 44 are formed as the particles are encapsulated by the matrix. That is, a convex bulge in the exposed surface 40 is formed by an underlying particle 50. In addition, the projection 44 may be formed by an exposed portion of the particle 50. That is, the particle 50 is partially embedded in the contact layer 40 and a portion of the particle is exposed as a projection 44.

[0033] The matrix 46, which carries the particles 50, is selected in conjunction with the particles 50 to provide a sufficient bond to preclude separation of the particles from the matrix as well as preclude unintended separation of the matrix from the weatherseal body 20.

[0034] The particulated polymeric matrix 46 can be formed as a layer, film, or laminate. However, it is understood at least a portion, or the entire weatherseal body 20 can be formed of the material of the particulated polymeric matrix.

[0035] The particulated matrix 46 can have any of a variety of thicknesses, as dictated by the intended operating environment of the weatherseal 10. For example, the particulated matrix 46 thickness can be from approximately 40 microns to approximately 1,000 microns. It has been found that for increased flexibility of the weatherseal 10 a reduced thickness of the particulated matrix 46 is advantageous. The particle size is selected in conjunction with the desired thickness of the particulated matrix 46. The particle size may be in a range of approximately 20 microns to approximately 200 microns, with a selected range of approximately 35 microns to approximately 120 microns, and a preferred range from approximately 35 microns to approximately 65 microns. For those configurations wherein it is desirable to entirely embed particles within the matrix, the particle size is less than a thickness of the matrix.

[0036] The particulated matrix 46 can be a thermoplastic resin such as an olefin, and may include polypropylene or polyethylene with a low melt flow index. It is

understood that fillers, binders or other additives may be included in the matrix 46. Preferably, the thermoplastic resin of the matrix 46 is selected to bond to the material of the weatherseal body 20 without requiring secondary adhesives. However, it is understood that secondary adhesives can be employed.

[0037] Alternatively, the particulated matrix 46 can be formed of a thermosetting resin which is curable by any of a variety of mechanisms including chemical, heat, and radiation. Typical materials for the thermosetting resin include, but are not limited to, cross linkable urethane or a rubber based compound such as EPDM and modified EPDM.

[0038] The particles 50 may be formed of any of a variety of materials including ceramic, mineral, thermoset or thermoplastic materials. Typical materials for the particles 50 include polyethylene, UHMW (ultra high molecular weight) polyethylene, polypropylene, polyamide or cross linked versions thereof. It is also understood the particles 50 can be surface treated to enhance adhesion in the contact layer. Preferably, the particles 50 are non-degrading to the panel 14 and are sufficiently bonded in the polymeric matrix to preclude separation during manufacture, installation or use of the weatherseal 10. The multitude of particles 50 forming can be formed of different materials. That is, a first portion of the multitude of particles can be a first material and a second portion of the multitude of particles can be a different second material.

[0039] The multitude of particles 50 are retained in the polymeric matrix 46, shown schematically in Figure 5. Preferably, the plurality of particles 50 are chemically bonded to the polymeric matrix 46 to preclude separation during manufacture, installation or use of the weatherseal 10. However, it is anticipated that adhesives or bonding agents may be employed to assist in retention of the particles 50 in the matrix 46. Preferably, the particles 50 and the polymeric matrix 46 are selected to form a sufficient chemical bond without requiring secondary adhesives. It is also contemplated the particles 50 may be connected to the polymeric matrix 46 or retained in the polymeric matrix by mechanical connection. That is, the primary retention force results from corresponding structure between the particles 50 and the polymeric matrix 46 to mechanically retain the particles. Further, the particles 50 can be retained by a combined chemical bonding and mechanical retention.

[0040] The weatherseal body 20, the polymeric matrix 46 with the multitude of particles 50 are selected such that upon a compressive force against the contact layer and the projections, the particles are not substantially displaced into the contact layer or the underlying substrate. That is, the particles 50 maintain the area of contact between the weatherseal 10 and the panel 14, and the area of contact is not significantly increased upon an increase in the pressure.

[0041] The exposed surface of the particulated polymeric matrix 46 can be formed to exhibit different coefficients of friction, different visual appearances, different surface textures, different surface roughness. These different properties are provided by altering the location and/or orientation of the particles 50 relative to the exposed surface of the matrix 46. For example, the particulated polymeric matrix 46 can be surface treated such that the resultant surface of the matrix is substantially planar and the particles do not form projections 44. It is also contemplated the surface treatment of the particulated polymeric matrix can provide macro sized features such as embossing, which have a size scale substantially greater than the size of the individual particles 50. That is, the embossing can provide surface features on the order of 0.25mm to 3 mm, wherein the particles 50 can selectively form projections within the embossed surface feature.

[0042] Alternatively, the surface of the particulated polymeric matrix 46 can be selectively abraded or worn to provide a difference in surface characteristics such as coefficient of friction, texture, appearance, roughness. For example, impacting a flowable media against the initially formed particulated polymeric matrix 46 can result in a wearing or removal of the matrix material from overlying the particles 50. Thus, is contemplated the coefficient of friction can be further reduced in a particulated polymeric matrix 46 by removing the matrix material from the particles 50.

[0043] Thus, the particulated polymeric matrix 46 includes a multitude of particles 50 having a first relation/orientation relative to a surface of the matrix and a second plurality of particles having a different second relation/orientation relative to the surface of the matrix. It is understood that within a first longitudinal section of the polymeric matrix, individual particles within the first section may have slightly varying orientations or locations relative to the surface of the matrix, yet collectively, the entire plurality of

particles within the first section will define a generally uniform or distributed appearance (or characteristic), wherein within a different second longitudinal section (which has not been surface treated or has been subjected to a different surface treatment), will have a different cumulative appearance (or other selected characteristic). That is, the characteristics are determined over an area substantially greater than the dimension of the particles 50. For example, the surface roughness is not measured at the apex of a particle 50 and then at the adjacent surface of the matrix, to provide the difference in surface roughness. Rather, the surface roughness is taken over an area that is a multiple of times greater than the relevant particle size. Thus, the sections between which a given characteristic is compared have an area of at least one mm^2. Similarly, the surface texture is taken over a representative area substantially greater than the size of the particles 50. The visual and tactile characteristics providing a different appearance and feel of the surface are represented by areas of at least one mm^2 as opposed to a texture of a particle compared to the texture of the adjacent matrix.

[0044] The different (surface treated) sections of the particulated matrix can be defined by different average surface roughness, luster, reflectivity, or coefficient of friction (static or dynamic). Further, the different surface treated sections can have different distribution of particles throughout a cross section of the matrix. That is, for certain lengths of the weatherseal, the particles can be uniformly distributed throughout the thickness of the matrix, such that some particles project from the surface, while along other lengths of the weatherseal, the particles can be within the thickness of the polymeric material 48, without projecting from the surface. Typically, the number of particles per unit length of the matrix (weatherseal) is independent of the surface treatment. However, the location of particles across a given cross section of the matrix will vary depending upon the surface treatment. As seen in Figure 5, the dashed line schematically separates a first section of the particulated matrix and a second section of the particulated matrix. Referring to Figure 5, the average number of particles per unit length of the particulated matrix is constant, while the location of the particles in the surface treated section is determined by the surface treatment. However, it is understood that certain surface treatments may remove material from the matrix, and thus reduce the number of particles per unit length of the matrix.

[0045] It is contemplated that the surface of the particulated polymeric matrix 46 can be surface treated such that the presence of the multitude of particles within the matrix is substantially hidden or unobservable to the operator of the vehicle. Thus, the present invention allows a surface of the weatherseal body 20 to be formed of a single extruded mixture, wherein the extruded mixture can be selectively surface treated after formation, thereby allowing the single extruded mixture to provide or exhibit different aesthetic appeals, appearances and coefficients of friction along specific lengths or sections of the weatherseal 10.

[0046] Further, as seen in Figures 2-4, the surface treated sections of the particulated polymeric matrix 46 can be spaced along the longitudinal dimension of the weatherseal 10. Alternatively, the surface treated sections can be located at a given longitudinal position and are spaced in a transverse direction. Referring to Figure 6, the particulated matrix 46 can be any of a variety of shapes or profiles, wherein the surface treated sections are within the shape or profile of the matrix. Alternatively, the entire exposed surface 40 could include the particulated matrix, and the reference 46 in Figure 6 identifies the surface treated areas of the particulated matrix.

Method of Manufacture

[0047] The weatherseal body 20 can be formed by any of a variety of conventional manufacturing methods, such as extrusion or molding, with or without a reinforcing member 22.

[0048] The particulated polymeric matrix 46 can be formed in any of a variety of configurations such as a pre-formed tape, co-extruded with the weatherseal body 20 or a subsequently extruded onto the weatherseal body.

[0049] For example, in an extrusion process, the multitude of particles 50 are mixed with the polymeric matrix 46. The weatherseal body 20 can then be extruded and the mixture of particles 50 and in the matrix 46 is co-extruded or subsequently extruded onto the weatherseal body. If thermosetting materials are employed, subsequent curing by any of the known methods may be employed. It is contemplated that the particles 50 are selected to retain their integrity and avoid substantial degradation upon curing of any thermosetting portion of the weatherseal 10.

[0050] Alternatively, the particles 50 may be introduced into the exposed surface 40 after extrusion of the polymeric matrix by any of a variety of deposition methods such as spreaders, sprayers or rollers. Thus, the particulated matrix can include particles 50 which are spread, sprayed or rolled onto or into the polymeric matrix.

[0051] In the tape configuration, the particles 50 are incorporated into the polymeric matrix which is formed as a ribbon or tape. The tape may be coextruded with the weatherseal body 20 or subsequently attached to the weatherseal body by mechanical bonding, heat bonding, adhesives or a combination thereof.

[0052] After formation of the particulated polymeric matrix 46 and weatherseal body 20, wherein the particulated matrix is disposed on the weatherseal body to form an exposed surface, the particulated polymeric matrix is surface treated, such as by embossing, electric stimulation, grinding, brushing, burnishing, impacting with flowable media, electromagnetic fields, rolling and/or calendaring.

[0053] In the extrusion process, the initial formation of the weatherseal body 20 and particulated polymeric matrix 46 results in a multitude of surface projections 44 in the particulated matrix, wherein the projections are formed by projecting particles or a portion of the polymeric matrix being distended by an underlying particle. Post formation, or downstream processing such as rolling, embossing or calendaring typically includes contacting of the rough particulated polymeric matrix 46 with a hard surface, such that the resulting surface treated polymeric matrix exhibits a different surface roughness. In fact, it is contemplated the surface treating can be employed to substantially smooth a previously rough particulated matrix surface. Thus, the sections of the particulated polymeric matrix 46 can have differing coefficients of friction, wherein the surface treated section of the particulated polymeric matrix will have a different coefficient of friction.

[0054] As the particulated polymeric matrix 46 is of a single constituency, the extruding equipment does not need to be adjusted or modified in those areas where the particulated surface is not desired. The downstream processing, such as embossing or calandering is applied to transform selected areas of the matrix.

[0055] While a preferred embodiment of the invention has been shown and described with particularity, it will be appreciated that various changes and modifications

may suggest themselves to one having ordinary skill in the art upon being apprised of the present invention. It is intended to encompass all such changes and modifications as fall within the scope and spirit of the appended claims.